
NASA-08510 (June 2003)
NATIONAL AERONAUTICS NASA
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(March 2003)

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DIVISION 08 - DOORS AND WINDOWS

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SECTION 08510

STEEL WINDOWS

06/03

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers steel windows, window screens, and related accessories. Types include projected, casement, combination, classroom, and security steel windows.

Glass and installation are specified in Section 08810, "Glass."

Quality classifications include heavy-intermediate, intermediate, and industrial steel windows.

Sealing perimeter joints between windows and other construction is specified in Section 07920 "Sealants and Calkings."

Drawings must indicate window locations, size, type, ventilator swing or direction of movement, screens, glass thickness, glazing method, construction details, accessories, fittings, mullion details, and closures required for a complete installation.

Steel windows may be fire-rated for Class E (moderate fire exposure) and Class F (light fire exposure) and may receive the UL label when constructed and glazed in accordance with NFPA and UL requirements.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be manually edited except to add new references.

References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

ALUMINUM ASSOCIATION (AA)

AA 45 (1997) Designation System for Aluminum
Finishes

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2002) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME A39.1 (1987; Special Notice August 1987; Addenda
A 1988) Safety Requirements for Window
Cleaning

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2002) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A 307 (2000) Standard Specification for Carbon
Steel Bolts and Studs, 60,000 psi Tensile
Strength

ASTM A 36/A 36M (2001) Standard Specification for Carbon
Structural Steel

ASTM A 366/A 366M (1996) Standard Specification for Steel,
Sheet, Carbon, Cold-Rolled, Commercial
Quality

ASTM A 47/A 47M (1999) Standard Specification for Ferritic
Malleable Iron Castings

ASTM A 501 (1993) Standard Specification for
Hot-Formed Welded and Seamless
Carbon-Steel Structural Tubing

ASTM A 563 (2000) Standard Specification for Carbon
and Alloy Steel Nuts

ASTM A 563M (2000) Standard Specification for Carbon
and Alloy Steel Nuts (Metric)

ASTM A 568/A 568M (2002) Standard Specifications for Steel,

	Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 569/A 569M	(1991; Rev A) Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 570/A 570M	(1996) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B 117	(1995) Operating Salt Spray Apparatus (Fog)
ASTM B 244	(1979; R 1993) Standard Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM D 1005	(1995) Measurement of Dry Film Thickness of Organic Coatings Using Micrometers
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors, Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1993) Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 437	(1992) Standard Specification for Cloth and Screen, Industrial Wire (Square Opening Series)
ASTM F 568M	(1998) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
ASTM F 835	(1992) Screws, Cap, Socket Button and Flat Countersunk Head, Alloy Steel
ASTM F 835M	(1992) Screws, Cap, Socket Button and Flat

Countersunk Head, Alloy Steel (Metric)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.18 (1987) Materials and Finishes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1992) Standard for Fire Doors and Fire Windows

STEEL WINDOW INSTITUTE (SWI)

SWI-01 (1989) The Specifier's Guide to Steel Windows

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 27 (1991) Basic Zinc Chromate - Vinyl Butyral Wash Primer

SSPC SP 1 (1982) Solvent Cleaning

SSPC SP 10 (2000) Joint Surface Preparation, Standard Near-White Metal Blast Cleaning (NACE No. 2)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-C-271 (Rev D) Chains and Attachments, Welded and Weldless

FS TT-P-645 (Rev B) Primer, Paint, Zinc-Molybdate, Alkyd Type

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (1999) Building Materials Directory

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330, "Submittal Procedures," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with

the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted in accordance with paragraph entitled, "General," of this section.

Installation Drawings shall include the following information:

Plans and elevations of windows indicating location, window dimensions, mullion and muntin arrangement, fixed operating sash, glazing arrangement, size and spacing of anchors and fasteners, ventilator operation, method of glazing, location of operating hardware, and weatherstripping details.

Location of window and Shade Screens.

Details of spacing and anchoring Window Cleaners' Bolts.

Detail sections of Security Windows, screens and Fire-Rated Windows.

Certificates for paint materials and galvanizing materials shall be submitted in accordance with paragraph entitled, "Finish," of this section and shall show conformance with the referenced standards contained in this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for paint materials and galvanizing materials shall be submitted in accordance with paragraph entitled, "Finish," of this section, referencing applicable standards in this section.

Glazing
Weatherstripping
Projected Windows
Casement Windows
Combination Windows
Classroom Windows
Commercial Projected Windows
Horizontally Pivoted Windows
Security Windows
Fixed Windows
Fire-Rated Windows
Operating Hardware
Galvanized Finish
Mullions
Screens
Window Cleaners' Bolts
Steel Subframes

SD-04 Samples

Contractor shall submit the following samples:

One complete full size sample window of each type, complete with hardware, weatherstripping, anchors, screen, glazing beads, and an operator ventilator if typical of project requirements.

Contractor shall submit one full-sized sample of steel subframe including window-casing stool, sill, and trim.

After approval, each sample shall be installed in the work where directed, and the location shall be recorded for the following items:

- Projected Windows
- Casement Windows
- Combination Windows
- Classroom Windows
- Commercial Projected Windows
- Horizontally Pivoted Windows
- Security Windows
- Fixed Windows
- Fire-Rated Windows
- Steel Subframes

SD-06 Test Reports

Test reports for the following items shall be in accordance with the tests described in the paragraph entitled, "Performance Requirements," of this section.

- Horizontal Deflection
- Vertical Deflection
- Torsion

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

- Glazing
- Weatherstripping
- Projected Windows
- Casement Windows
- Combination Windows
- Classroom Windows
- Commercial Projected Windows
- Horizontally Pivoted Windows
- Security Windows
- Fixed Windows
- Fire-Rated Windows
- Operating Hardware
- Mullions
- Screens
- Window Cleaners' Bolts

Steel Subframes

1.3 INTERPRETATION OF AWS CODE

NOTE: If Section 05095, "Welding Steel Construction," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 05095, "Welding Steel Construction," applies to work specified in this section.

AWS code, when referred to herein, shall mean: AWS D1.1/D1.1M "Structural Welding Code - Steel" with the following modification:

Revise AWS code, Section 1, "General Provisions," Paragraph 1.1 as follows: References to the need for approval shall mean "Approval by the Contracting Officer" and all references to the "Building Commissioner" shall mean the "Contracting Officer."

1.4 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of drawings and fabrication.

1.5 DELIVERY, HANDLING, AND STORAGE

Windows, mullions, accessories, and trim shall be delivered in the manufacturer's unbroken containers and shall be handled carefully at all times to prevent damage.

Windows shall be stored on edge aboveground and protected from the weather in accordance with the manufacturer's directions.

1.6 PERFORMANCE REQUIREMENTS

1.6.1 Performance Tests

Windows shall meet specified test requirements.

Tests shall be performed by an approved commercial testing laboratory.

Windows tested shall be either the windows proposed for use in the project or windows of the same type and design.

Test specimens shall be the manufacturer's largest size with the following minimum ventilator dimensions:

<u>WINDOW TYPE</u>	<u>VENTILATOR WIDTH</u>	<u>VENTILATOR HEIGHT</u>
Casement	24 inches	48 inches

<u>WINDOW TYPE</u>	<u>VENTILATOR WIDTH</u>	<u>VENTILATOR HEIGHT</u>
Projected	48 inches	32 inches
<u>WINDOW TYPE</u>	<u>VENTILATOR WIDTH</u>	<u>VENTILATOR HEIGHT</u>
Casement	600 millimeter	1220 millimeter
Projected	1220 millimeter	815 millimeter

Performance tests for projected and casement windows shall include the following:

Air infiltration: Air infiltration shall not exceed 1/2 cubic foot per minute per foot 2.36 by 10⁻⁴ cubic meter per second per meter of crack length when tested in accordance with ASTM E 283.

Water leakage: There shall be no water leakage when tested in accordance with ASTM E 331.

Uniform-load structural test:

There shall be no glass breakage, permanent damage to fasteners, hardware parts, support-arms, actuating mechanism, nor any other damage causing the window to be inoperable and no permanent deformation of frame or sash member in excess of 0.4 percent of its span when tested in accordance with ASTM E 330.

Mullions: When tested with windows, mullions shall be tested at the same pressure and shall be subject to the same specification requirements as the windows.

NOTE: Delete the following tests if projected windows are not required for the project.

Projected windows shall be subjected to the following additional tests.

Horizontal Deflection: A completely assembled window and ventilator without muntins, unglazed, with ventilator closed and locked, shall be securely supported in the window frame. A concentrated load of 20 pounds 90 newton shall be applied at either unrestrained corner of the ventilator, acting outward and normal to the plane of the window. The resulting deflection of the ventilator corner as measured from its normally closed position shall not exceed 5/16 inch 8 millimeter and, upon removal of the load, the ventilator shall close and operate properly.

Ventilator torsion: A completely assembled window shall be continuously supported around its periphery with a ventilator opened 45 degrees. One corner of the open ventilator shall be secured in this open position by blocking it against the fixed portion of the window. A concentrated load of

30 pounds 130 newton shall be applied at the outer horizontal rail of the ventilator, acting at the point of the locking-handle attachment in a direction normal to the plane of the fixed portion of the window. Under this load the deflection of the opposite free corner of the ventilator shall not exceed 3-1/2 inches 90 millimeter measured normal to the plane of the fixed portion; when the test is concluded, the ventilator shall open and close freely under an operational force of not more than 15 pounds 67 newton after the ventilator is in motion.

NOTE: Delete the following tests if casement windows are not required for the project.

Casement windows shall be subjected to the following additional tests.

Horizontal deflection: A completely assembled window and ventilator, without muntins, unglazed, and with locking hardware in the approximate center of the 48-inch 1220 millimeter ventilator rail in a locked position, shall be securely supported in the window frame. A concentrated load of 20 pounds 90 newton shall be applied at either unrestrained corner of the ventilator, acting outward and normal to the plane of the window. Resulting deflection of the ventilator corner measured from its normally closed position shall not exceed 5/16 inch, 8 millimeter, and, upon removal of the load, the ventilator shall close and operate properly.

Vertical Deflection: A completely assembled window and ventilator, without muntins, unglazed, and with the manufacturer's standard hardware installed, shall be supported in a window frame with the ventilator open at 90 degrees. A concentrated load of 60 pounds 265 millimeter shall be applied at the outer lower corner of the ventilator, acting vertically. Resulting deflection of the corner under this load shall not exceed 3/16 inch per foot 5 millimeter per 305 millimeter of ventilator width, and, upon removal of the load, the ventilator shall close and operate properly.

Torsion: Ventilator, without muntins and unglazed, shall be supported on fulcrums at diagonally opposite corners, with a third corner secured in the same plane by a fulcrum support block and clamp. A concentrated load of 20 pounds 90 newton shall be applied to the fourth corner acting normal to the plane of the ventilator. Under this loading, the deflection of this corner measured from the plane of the other three corners shall not exceed 1-1/2 inches. 38 millimeter. Upon removal of the load, the ventilator shall close and operate properly.

Hardware load: A completely assembled casement window having two ventilators of the manufacturer's largest standard size with hinges and roto-operating hardware shall be securely mounted in a vertical plane and rotated so that when both ventilators are fully open they are in horizontal planes. A uniformly distributed load of 6.25 pounds per square foot 300 pascal shall be applied to both ventilators acting normal to their planes. Under this loading the hardware shall support both ventilators without deflection, and at the conclusion of the test there shall be no failure or permanent deformation in any part of the operating mechanism, and the operators shall function properly.

1.6.2 Wind Loading Design Pressure

NOTE: Select the wind loading design pressure on windows as required by the height of windows above grade.

Refer to ANSI A58.1, and AAMA 302.9 For wind-velocity charts and appropriate formulas and tables for design selection.

30-Pound per square foot (psf) 1436 pascal (30-pound per square foot) design pressure should be considered for buildings less than 30 feet 9145 millimeter high, 35 psf 1675 pascal (35 psf) for buildings between 30 and 49 feet 9145 and 14935 millimeter (30 and 49 feet) high, and 45 psf 2155 pascal for buildings between 50 and 99 feet 15240 and 30175 millimeter (50 and 99 feet) high. The listed design pressures are minimums.

Insert pressure value.

Window components including mullions, hardware, and anchors shall be designed to withstand a wind-loading design pressure of [_____] pounds per square foot (psf). pascal.

PART 2 PRODUCTS

2.1 GENERAL

Fabrication Drawings shall include large-scale sections showing window profile, metal thickness and gage, and sill, jamb and head details for steel window units.

Windows shall be the type and quality indicated and shall meet or exceed SWI-01 and the requirements specified.

Windows shall be complete with mullions, mullion covers, closures, fins, hardware, fasteners, clips, anchors, and fittings as indicated and required for a complete installation.

2.2 MATERIALS

Windows shall be fabricated from hot-rolled steel conforming to ASTM A 569/A 569M.

Mullions shall be fabricated from hot-rolled steel conforming to ASTM A 569/A 569M.

Bronze for use as operating hardware and for screw-fastening bronze or malleable-iron hardware to frame members shall be suitable alloys composed

chiefly of copper with zinc and other elements as required to produce the desired appearance and other properties usually associated with red bronze or yellow brass.

Exposed machine-screw or bolt fasteners shall be zinc-coated carbon steel conforming to ASTM F 835, ASTM F 835M, coarse or fine thread series, with flat head, truss head, or pan head, as required for the end use.

Concealed bolt fasteners shall be zinc-coated carbon steel conforming to ASTM A 307, ASTM F 568M, hexagon head or type of head and thread series suitable for the end use.

Nuts shall be plain hexagon, square, and acorn zinc-coated carbon steel, conforming to ASTM A 563, ASTM A 563M, square regular, or hexagon, plain.

2.3 GLAZING

[Windows shall be prepared for outside/inside glazing using clips and glazing compound as specified in Section 08810, "Glass," except that glass panes over 1,000 square inches 645160 square millimeter in area and 1/2-inch 13 millimeter insulating glass shall be secured with screw-attached adjustable glazing clips furnished by the window manufacturer.]

[Windows shall be prepared for inside glazing with metal glazing beads furnished by the window manufacturer. Beads shall be the screw-in or snap-in type as indicated.]

2.4 WEATHERSTRIPPING

NOTE: Weatherstripping should be limited to heavy-intermediate and to intermediate quality windows only.

Each ventilator shall be single weatherstripped by means of closed-cell sponge neoprene weatherstripping installed in an integral weatherstripping groove in the ventilator frame. Neoprene shall conform to ASTM D 1056, Type S, Grade SBE-41.

2.5 WINDOW TYPE

NOTE: Selection of projected, casement, combination, and classroom windows is limited to heavy-intermediate and intermediate windows.

2.5.1 Projected Windows

Windows shall be the grade specified, with the size and ventilator arrangement indicated, conforming to SWI-01 and the following:

Ventilators shall be supported on flat, steel balance arms not less

than 3/16 inch thick by 1 inch wide, rivet-attached to vents and frame with 3/8 inch diameter shoulder pivots. Rivet holes shall be fitted with bronze bushings. Ventilators shall be held in any open position by spring-loaded bronze friction shoes in sliding contact with frames. Compression springs shall be enclosed in metal housings riveted to the ventilator rails.

Ventilators shall be supported on flat, steel balance arms not less than 5 millimeter thick by 25 millimeter wide, rivet-attached to vents and frame with 10 millimeter diameter shoulder pivots. Rivet holes shall be fitted with bronze bushings. Ventilators shall be held in any open position by spring-loaded bronze friction shoes in sliding contact with frames. Compression springs shall be enclosed in metal housings riveted to the ventilator rails.

Ventilator assembly shall be designed to permit field removal and replacement after installation and shall provide an adjustable stop to permit a maximum opening angle of 50 degrees.

Outward projecting ventilators shall have a bottom-rail clearance not less than 6 feet 1800 millimeter above the finished grade.

2.5.2 Casement Windows

Windows shall be the grade specified, with the size and ventilator arrangement indicated, conforming to SWI-01 and the following:

[Roto-operated side-hinged casements shall be hung on extension nonfriction steel hinges limited to a maximum opening of 105 degrees. Hinges shall be fitted with solid bronze pivots not less than 3/8 inch 10 millimeter in diameter with bronze or brass washers. Hinge leaves shall be continuous-welded to the ventilator and frame. Each casement operator shall have a roto-operator and a through-rail bronze locking handle at the swing jamb.]

[Simplex-operator side-hinged casements shall be hung on extension friction steel hinges limited to a maximum opening of 105 degrees. Hinges shall be fitted with solid-bronze pivots not less than 3/8 inch 10 millimeter in diameter with bronze or brass washers. Hinge leaves shall be continuous-welded to the ventilator and the frame. Each casement ventilator shall have a sliding underscreen operator and a surface-mounted bronze locking handle at the swing jamb.]

Outswinging vents shall have a bottom-rail clearance not less than 6 feet 1800 millimeter above the finished grade.

2.5.3 Combination Windows

Combination windows shall be the size and type indicated conforming to SWI-01. Ventilator arrangement shall be a combination of the projected and casement types as specified.

2.5.4 Classroom Windows

Classroom windows shall be the size and type indicated conforming to SWI-01. Ventilator arrangement shall be the projected type as specified.

2.5.5 Commercial Projected Windows

Commercial projected windows shall be heavy custom, size and type as indicated, conforming to SWI-01 and the following:

Ventilator corners shall be welded at web intersections. Fixed meeting rails shall have the end connections reinforced by welding. Weathering members shall be welded to framing members and sealed from the weather.

Outward-projecting ventilators shall have a bottom-rail clearance not less than 6 feet 1800 millimeter above the finished grade.

[Windows shall be prepared for screens.]

2.5.6 Horizontally Pivoted Windows

Horizontally pivoted windows shall be heavy custom, size and ventilator arrangement as indicated, conforming to SWI-01 and the following:

Ventilators shall be hung on steel hinge brackets not less than 3/16 inch thick by 3/4 inch wide, riveted to the frame jamb and to the ventilator with bronze bushed, steel shoulder rivets.

Ventilators 6 feet or less from floor shall have steel, locking staybar operating hardware. Ventilators over 6 feet from the floor shall have a spring latch and chain.

Ventilators shall have a bottom-rail clearance not less than 6 feet above the finished grade.

Ventilators shall be hung on steel hinge brackets not less than 5 millimeter thick by 20 millimeter wide, riveted to the frame jamb and to the ventilator with bronze bushed, steel shoulder rivets.

Ventilators 1800 millimeter or less from floor shall have steel, locking staybar operating hardware. Ventilators over 1800 millimeter from the floor shall have a spring latch and chain.

Ventilators shall have a bottom-rail clearance not less than 1800 millimeter above the finished grade.

2.5.7 Security Windows

Security windows shall be industrial grade, size and ventilator arrangement as indicated, conforming to SWI-01 and the following:

Joints and corners of window and ventilator frames shall be welded in addition to mechanical interlocking and riveting.

Muntin bars in fixed-window sections shall be spaced to provide a glass opening not more than 7 inches 180 millimeter wide.

Ventilators shall project in and the ventilated section shall have a guard frame superimposed on the window exterior with all guard bars welded in place. Guard bars shall align exactly with fixed muntins in the frame section of the window.

[Windows shall be prepared for screens mounted on the outside of the guard frame.]

[Windows shall be prepared for screens mounted between the ventilator and the guard frame.]

2.5.8 Fixed Windows

Fixed windows shall be heavy custom, size as indicated, conforming to SWI-01.

2.6 WINDOW GRADE

2.6.1 Heavy-Intermediate Grade Windows

NOTE: Heavy-intermediate windows should be considered for offices, laboratories, administration buildings, and similar institutional applications when the project requires a high-quality first-class appearance heavy-section window designed to provide a large vent size, a wide selection of window sizes and glazing methods, and a capability to receive insulating and heat-absorbing glass.

Selection is limited to a combined weight of the frame and ventilator of 3.5 pounds per linear foot. 5.2 kilogram per meter. Specification will have to be revised to provide a heavier weight if required.

Windows shall conform to SWI-01 and the following:

Combined weight of the frame and ventilator perimeter members shall be not less than 3.5 pounds per linear foot.

Combined weight of the frame and ventilator perimeter members shall be not less than 5.2 kilogram per meter.

Combined depth of frame and ventilator perimeter members shall be not less than 1-1/2 inches. 40 millimeter.

Frame and ventilator sections shall have weathering baffles rolled as integral parts of the section to provide parallel double-contact surfaces not less than 1/4 inch wide around the perimeter of the ventilator.

Frame and ventilator sections shall have weathering baffles rolled as integral parts of the section to provide parallel double-contact surfaces not less than 6 millimeter wide around the perimeter of the ventilator.

Muntins shall be attached to the frame and the ventilator with mortise-and-tenon joints; intersections shall be interlocked and welded with flush interior surfaces.

Windows shall be prepared for screens.

**NOTE: Include the following paragraph if insulating
or heat-absorbing glass is specified for the project.**

Rebbets not less than 7/8 inch 22 millimeter high and matching glazing beads shall be provided in windows indicated to receive 1/2-inch 13 millimeter insulating glass or 1/4-inch 6 millimeter heat-absorbing glass.

2.6.2 Intermediate-Grade Windows

**NOTE: Intermediate windows should be considered for
general application in offices, laboratories, and
for similar use where window size and project
requirements do not require the heavy-intermediate
window.**

**This window is available in bead or compound
glazing, interior and exterior.**

Windows shall conform to SWI-01 and the following:

Combined weight of the frame and ventilator perimeter members shall be not less than 3.1 pounds per linear foot.

Combined weight of the frame and ventilator perimeter members shall be not less than 4.6 kilogram per meter.

Depth of the frame and ventilator perimeter members shall be not less than 1-1/4 inches. 32 millimeter.

Frame and ventilator sections shall have weathering baffles rolled as integral parts of the section to provide parallel double-contact weathering surfaces not less than 1/4-inch wide around the perimeter of the ventilator.

Frame and ventilator sections shall have weathering baffles rolled as integral parts of the section to provide parallel double-contact weathering surfaces not less than 6 millimeter wide around the perimeter of the ventilator.

Muntins shall be attached to the frame and the ventilator with mortise-and-tenon joints; intersections shall be interlocked and welded with flush interior surfaces.

Windows shall be prepared for screens.

2.6.3 Heavy Custom Windows

NOTE: Heavy custom windows should be considered for storage buildings, shops, utility buildings, hangars, warehouses, and similar uses. Windows are prepared for inside compound glazing. The projected and security industrial window can be fitted with screens. Screens cannot be used with pivoted windows.

Windows shall conform to SWI-01 and the following:

Windows shall be arranged for inside glazing using a glazing compound and glazing clips as specified in Section 08810, "Glass."
Frame members shall be not less than 1-3/8 inches deep; the ventilator frame shall be not less than 1-1/2 inches deep. Sections shall be nominally 1/8 inch thick except that applied weatherstripping shall be not less than 0.060 inch thick.

Muntins shall be T-sections not less than 1-3/8 inches deep, 1/8 inch thick, with glazing rabbets not less than 5/16 inch high.

Frame members shall be not less than 35 millimeter deep; the ventilator frame shall be not less than 40 millimeter deep. Sections shall be nominally 3 millimeter thick except that applied weatherstripping shall be not less than 1.5 millimeter thick.

Muntins shall be T-sections not less than 35 millimeter deep, 3 millimeter thick, with glazing rabbets not less than 8 millimeter high.

2.7 FIRE-RATED WINDOWS

NOTE: Delete the paragraph heading and the following paragraphs if fire-rated windows are not required.
Width and height restrictions are defined in NFPA 80, section 12.

Windows shall be the quality and type indicated, constructed in accordance with the requirements of NFPA 80, and a type listed and labeled in UL Bld Mat Dir (120 IWO).

Nonstructural mullions between multiple fire windows shall be UL-labeled

steel as listed in the UL Bld Mat Dir (120 IW13).

Window manufacturer shall furnish glazing clips or glazing angles as required for the indicated class of fire window.

2.8 HARDWARE

NOTE: Select hardware as required for the type and grade of windows.

Operating Hardware for heavy-intermediate and intermediate grade windows shall be solid bronze castings and shapes, BHMA finish No. 612 in accordance with BHMA A156.18. Hardware shall be a modern design, smoothly finished, free of defects, and suitable for the intended purpose.

Operating hardware for industrial-grade steel windows shall be malleable iron conforming to ASTM A 47/A 47M, [Grade 32510,] [Grade 22010,] finish in accordance with BHMA A156.18. Hardware shall be a modern design, smoothly finished, free from defects, and suitable for the intended purpose.

Cam-action locking handles and strikes shall be provided for projected-out vents; cam-action locks and keepers shall be provided for projected-in vents. Pole-operated projected-in vents shall be equipped with suitable design cam-action locks or spring-catch fasteners.

Projected-type ventilators 54 inches 1372 millimeter and wider and not pole operated shall be furnished with two sets of cam-action locking hardware.

Pole operators shall be provided for projected-type ventilators located 6 feet 1800 millimeter and higher above the finished floor. Poles shall be tubular steel, wood, or aluminum and shall include a cast bronze pole hanger for each pole operator. One pole operator, length as required, shall be provided for each room requiring pole operation.

Sash operators for casement windows shall be the crank-operated rotary or sliding underscreen type. Rotary operators shall be angle drive with bronze or corrosion-resistant steel worm drive, gear of a suitable bronze alloy to mate with the worm, all other parts bronze or brass. Locking handles shall be the solid-bronze pivoted-lever type, engaging a beveled strike plate or keeper. Ventilators exceeding 66 inches 1675 millimeter in height shall have a two-point locking device operated by concealed rods from a single lever handle. Sliding underscreen friction operators shall be solid bronze or brass. Operators shall be designed to hold ventilators firmly in position at any angle up to 90 degrees.

2.9 HARDWARE FOR MULTIPLE-SASH OPERATION

NOTE: Drawings must indicate the location of operators, length of run for each operator, and details of special-construction conditions.

Manufacturer's data should be checked to aid proper selection.

Hardware and controls shall be provided for manually operated multiple-sash operation where indicated and shall be complete with the brackets, bolts, clips, anchors, and fittings required for a complete and operable installation.

Hardware fittings and controls for mechanical operators shall conform to SWI-01 and the following:

Shaft brackets shall be steel with adjustable brass roller bearings. Spacing of shaft brackets shall not exceed 8 feet.

Pipe shafts shall be not less than 1-5/16-inch outside diameter.

Shaft brackets shall be steel with adjustable brass roller bearings. Spacing of shaft brackets shall not exceed 40 millimeter.

Pipe shafts shall be not less than 33 millimeter outside diameter.

Worm-and-gear assemblies shall be cast iron or steel with machine-cut teeth, ball bearing, mounted in oil-bath, enclosed housings. Gear housings shall be factory lubricated and sealed.

Operators, shafts, connecting arms, brackets, and control handles shall receive a factory-applied rust-inhibiting primer coat applied to a dry-film thickness of not less than 2 mils. 0.05 millimeter.

[Operation shall be by means of a hand chain. Chain shall be cadmium-plated alloy steel conforming to FS RR-C-271, Type I, Grade C, Class 1.]

[Operation shall be by vertical shaft and miter gear with a detachable operating handle. Miter gear box shall be an oil-bath, enclosed housing.]

[Operator shall be a worm-and-gear torsion lever type.]

[Operator shall be a worm-and-gear torsion rack-and-pinion type. Racks shall be die-cut steel bars meshing with a die-cut steel pinion.]

[Operator shall be a screw type assembled in an enclosed housing and containing a threaded phosphor-bronze gear and cast-iron miter gear mounted on antifriction thrust bearings.]

NOTE: The following paragraph must be included.

Completed installation shall operate smoothly without binding and with no noticeable difference in the opening angle between windows in the entire length of the run. Windows shall open and close simultaneously with not

more than a 1-inch 25 millimeter difference in opening between the first and the last window at the end of the run and with not more than 5 degrees difference in the angle between connecting arms at the maximum window opening.

2.10 FINISH

2.10.1 Prime-Coat Finish

Windows, mullions, screens, and accessories shall receive a shop prime-coat finish in accordance with SWI-01 and as follows:

Materials shall be mechanically or chemically cleaned in accordance with SSPC SP 10 or SSPC SP 1. Material shall then receive one coat of baked-on primer.

Primer shall conform to FS TT-P-645 and shall have a dry-film thickness of not less than 2.0 mils when tested in accordance with ASTM D 1005.

Coating shall show no loss of adhesion 1/8 inch beyond the panel edges, no blisters, and no evidence of corrosion when tested in accordance with ASTM B 117 (salt-spray test), 250-hour exposure.

Primer shall conform to FS TT-P-645 and shall have a dry-film thickness of not less than 0.05 millimeter when tested in accordance with ASTM D 1005.

Coating shall show no loss of adhesion 3 millimeter beyond the panel edges, no blisters, and no evidence of corrosion when tested in accordance with ASTM B 117 (salt-spray test), 250-hour exposure.

2.10.2 Galvanized Finish

Window, mullions, screens, and accessories shall receive a hot-dip galvanized finish in accordance with ASTM A 123/A 123M.

NOTE: Delete the following paragraph if galvanized windows will not require a finish prime coat.

After galvanizing, materials shall receive a wash primer pretreatment in accordance with SSPC Paint 27, and shall then be primed with a baked-on zinc-chromate primer.

2.10.3 Factory Finish

Windows, mullions, screens, and accessories shall receive a factory-applied baked-on color finish as follows:

Materials shall be mechanically or chemically cleaned in accordance with SSPC SP 10 or SSPC SP 1.

Materials shall then be given a multiple coat baked-on thermosetting

acrylic enamel, alkyd melamine, or a 1-coat polyvinylchloride plastisol finish. Coating shall have a minimum dry thickness of 6 mils in accordance with ASTM D 1005.

Materials shall then be given a multiple coat baked-on thermosetting acrylic enamel, alkyd melamine, or a 1-coat polyvinylchloride plastisol finish. Coating shall have a minimum dry thickness of 0.15 millimeter in accordance with ASTM D 1005.

2.10.4 Repair Paint

Paint for touchup repairing of shop-primed and painted windows shall be a compatible paint of the same formulation and color as the factory finish.

2.11 MULLIONS

NOTE: Delete the paragraph heading and the following paragraphs if mullions are not required.

Drawings must indicate the profile and dimensions of mullions, anchorage, and reinforcing members as required for wind loading and the type, profile, and fastening system for the mullion cover (screw-fastened or snap-on).

Mullions shall be provided between multiple-window units where indicated.

Mullions and mullion covers shall be the profile and thickness indicated, reinforced as required for the specified wind loading.

Mullion assembly shall include galvanized-steel window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover shall be screw-fastened to the mullion.

Mullions shall be standard T-bar or plate type not less than 1/8 inch 3 millimeter thick and designed to permit horizontal dimensional adjustment.

Mullions shall be steel plate for windows up to 65 inches 1650 millimeter in height and hot-rolled T-bar shapes for windows 65 inches 1650 millimeter and over in height.

2.12 MULLION REINFORCING MEMBERS

NOTE: Delete the paragraph heading and the following paragraphs if mullion reinforcement is not required.

Drawings must indicate mullion reinforcing members and must detail the fastening method to the adjacent construction.

Reinforcing members shall be formed from steel sheets conforming to ASTM A 570/A 570M, Grade 36, steel shapes conforming to ASTM A 36/A 36M, or steel tubing conforming to ASTM A 501.

Reinforcing members shall be concealed and welded or bolted to the adjacent construction as indicated.

2.13 SCREENS

NOTE: Drawings must indicate the screen locations in elevations and should show screens in detail sections.

Delete the paragraph heading and the following paragraphs if screens are not required.

Removable, rewireable, interchangeable insect screens shall be provided for window openings as indicated and shall be complete with installation hardware and fasteners.

Frames shall be formed steel sections conforming to the requirements of SWI-01 and the following amendments:

Frames shall have the same finish as that specified for windows.

Frames shall be not less than 3/4 inch deep for fixed screens for project-in ventilators and roto-operated casements and not less than 1 inch deep for screens with sliding wickets for projected-out ventilators and simplex-operated casements.

Frames shall be not less than 20 millimeter deep for fixed screens for project-in ventilators and roto-operated casements and not less than 25 millimeter deep for screens with sliding wickets for projected-out ventilators and simplex-operated casements.

Frames for project-in vents, where the screen is attached on the window exterior, shall be AISI 300 series corrosion-resistant steel with corrosion-resistant steel or bronze wire fabric.

Corners shall be mitered, welded, and dressed smooth and flush. Frames shall include integral formed grooves to receive and retain screen splines. Splines shall be miter cut and shall provide neat close-fitting joints no wider than 1/32 inch. 0.794 millimeter.

Wire fabric shall be rewireable 18 by 14 mesh 1.0 by 1.4 millimeter (18 by 14 mesh) screen not less than 0.0113 inch 0.287 millimeter (0.0113 inch) diameter, conforming to ASTM E 437, bronze, corrosion-resistant steel, or Alclad aluminum alloy in a gunmetal finish. Screens shall be held taut and smooth by removable vinyl or steel splines.

Windows shall receive screens over ventilators where indicated. Horizontal sliding or hinged wicket type screens shall be provided where access to operating hardware is required. Wicket screens shall be framed with horizontal and vertical tubular or solid frame members and shall be equipped with friction catches.

2.14 SHADE SCREENS

NOTE: Delete the paragraph heading and the following paragraphs if heat and glare control screens are not required.

Drawings must indicate the location of this type of screen and must schedule all screened openings if both standard and shade screens are used. Consult the manufacturer's data and recommendations for specific installation practices.

Where indicated, removable louver-design shade screens shall be provided, complete with frame rails, braces, fasteners, and accessories as required for a complete installation.

Screens shall be fabricated from enamel-coated bronze woven into louvers approximately 0.05 inch wide by 0.05 inch 1.2 millimeter by 1.2 millimeter thick, color as selected, spaced at 23 louvers per inch, 25 millimeter, and set at an angle of 17 degrees from the horizontal. Screens shall have an area open to horizontal vision of 49 percent and a free air flow of 79 percent and shall also function as an insect screen.

Screens shall be framed in reinforced tubular aluminum rails at least 1/16 inch thick by 1/2 inch 1.6 millimeter thick by 13.0 millimeter wide by the height required for the screen size and shall be braced with 1/2 by 1 inch 13 by 25 millimeter extruded aluminum shapes. Perimeter of the screen shall be encased in vinyl caps and splines designed to fit the extrusion pockets of rails and braces.

Screens shall be hung and mounted in accordance with the drawing details and the shade-screen manufacturer's printed instructions.

Frame rails shall be 6063-T5 aluminum alloy and shall receive an AA Architectural Class II natural anodic coating AA-M12 C22 A31, in accordance with AA 45. Anodic coating shall be not less than 0.4 mil 0.01 millimeter in thickness when tested in accordance with ASTM B 244.

2.15 WINDOW CLEANERS' BOLTS

NOTE: Delete the paragraph heading and the following paragraphs if bolts are not required.

Window cleaners' bolts shall be provided for all windows 7 feet 2135

millimeter or higher above finished grade except windows located so they may be removed for cleaning or cleaned from the ground or from a lower roof level without the use of an extension ladder. Two bolts shall be provided for each single window unit and each fixed glass unit and shall be located 44 inches 1120 millimeter above the window sill.

Window cleaners' bolts shall be double-head type, AISI series 300 corrosion-resistant steel, size and design complying with ASME A39.1. Contact side of the bolts shall be ground to fit flat against window jambs.

Bolts may be factory- or field-attached before windows are set. Backs of frames to receive bolts shall be reinforced with 1/4- by 6-inch 6 by 150 millimeter corrosion-resistant steel or aluminum plates bolted or welded to the frames at the factory. Special wall anchors shall be provided on frames at the point of bolt attachment.

2.16 STEEL SUBFRAMES

NOTE: Delete the paragraph heading and the following paragraphs if subframes are not required.

If subframes are required, select the type required.

Drawings must indicate location, profile, and construction details of frames, single or double glazing subframe mullions and sills, and requirements for panels, louvers, or other special inserts.

Subframes shall be fabricated from hot-rolled structural-quality, new billet steel. Frame members shall be unequal-leg channel profile and shall have a depth of at least 2 inches 50 millimeter and a web thickness of at least 1/8 inch 3 millimeter. Corners shall be mitered, continuous welded, and dressed smooth at exposed and contact surfaces. Muntin and muntin-to-frame intersections shall be coped and notched or mortised and tenoned and machine welded. Finish shall be the same as that specified for windows.

Subframes shall be the size, profile, and design indicated and shall be fabricated from steel sheets conforming to ASTM A 366/A 366M, finish as specified, with a stretcher-level standard of flatness conforming to ASTM A 568/A 568M, not less than 0.1046 inch 2.657 millimeter thick, and free from pitting, scale, stretcher strains, fluting, and surface defects. Corner and post joints shall be coped and welded. Exposed joints and contact surfaces shall be continuous welded and ground smooth.

Finish shall be the same as that specified for windows.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Field Welding

Procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work shall conform to AWS D1.1/D1.1M, "Workmanship," and "Technique," and with the printed instructions of the window manufacturer and the approved drawings. Exposed welds shall be ground smooth.

3.1.2 General

Windows shall be set plumb, level to tolerance of not more than 1/16 inch in 10 feet 1.6 millimeter in 3000 millimeter, and in alignment without frame distortion, and securely anchored in place as indicated, in accordance with the manufacturer's printed instructions and the approved drawings.

Fasteners shall be concealed except for specifically indicated mullion covers, window-operating hardware, screen-attachment hardware, and similar surface-applied trim.

Steel work shall be drilled and tapped for attaching window units, trim, and accessories. Where window units are set in prepared masonry openings, anchorage items shall be placed during wall construction. Anchors and fasteners shall be welded or bolted securely to the frame and shall be built in, anchored, or bolted to the building construction with sufficient anchors to hold each window unit firmly in place. Anchors shall be not more than 18 inches 460 millimeter on center at heads, jambs, and sills.

Ventilators and operating parts shall be protected against cement, lime, plaster, adhesives, and other building materials after installation and until completion.

Joints shall be sealed between sash units, sills, mullions, and covers and similar metal-to-metal contact surfaces with sealant or tape as recommended and furnished by the window manufacturer. Installation shall be weathertight.

Joint sealing and calking between metal and masonry is specified in Section 07920 "Sealants and Calkings."

3.1.3 Touchup Painting

After installation of steel windows, field welds, field bolt heads and nuts, screw heads, and scarred surfaces on adjacent ferrous-metal surfaces shall be touchup painted. Before the start of touchup painting, weld scars, bruises, abrasions, and rust spots shall be wire brushed and solvent cleaned. Galvanized surfaces shall be touchup painted with galvanizing repair paint. Painted surfaces shall be painted using the same paint as used for the shop finish.

3.1.4 Installation of Labeled Fire Windows

**NOTE: Delete the paragraph heading and the
following paragraph if fire windows are not required.**

Installation of labeled fire windows shall be in accordance with NFPA 80.

3.2 ADJUSTMENT AFTER INSTALLATION

After the sash is erected and glazed, ventilators shall be lubricated and adjusted for smooth weathertight operation. Guides shall be waxed or lubricated and balances shall be adjusted for the proper tension.

**NOTE: Delete the following paragraph if
weatherstripped windows are not required.**

Weatherstripping shall make a weathertight contact around the entire weatherstripped area when ventilators are closed and locked. Weatherstripping shall not cause the sash to bind or prevent closing and locking the ventilator.

3.3 FEELER-GAGE FIELD TEST

**NOTE: Delete the paragraph heading and the
following paragraphs if weatherstripped windows are
selected.**

Windows shall be tested after installation, glazing, and adjustment for metal-to-metal contact between ventilators and frames by feeler-gage tests in accordance with SWI-01.

Windows failing to meet the requirements of the feeler-gage tests shall be corrected as required to meet the tests. Such windows shall be retested and, if they fail the tests again, shall be removed and replaced.

3.4 CLEANING AFTER INSTALLATION

Exterior and interior surfaces of windows shall be cleaned of mortar, plaster, paint spattering or spots, and other foreign matter, and washed with soap and water, brushed with a fiber brush, and thoroughly rinsed with clear water. Acid solutions, steel wool, or other harsh abrasives shall not be used.

Stained or discolored windows shall be cleaned in accordance with the window manufacturer's recommendations. Windows which cannot be satisfactory cleaned and windows with abraded, stained, or defective surface finish which cannot be satisfactorily repaired shall be replaced.

-- End of Section --